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PRELIMINARY INVESTIGATION OF SELECTED WATER QUALITY CONDITIONS IN THE LOWER COLORADO RIVER. PARKER DAM TO MORELOS DAM AND MEXICAN CANAL SYSTEM

PUBLIC HEALTH SERVICE, DENVER, COLORADO

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Limited water quality investigations were carried out on the lower Colorado River during the period July 11-25, 1961. Studies covered the section of the river from Parker Dam downstream to the U. S. - Mexico border, and were designed to determine whether any sections of the river were significantly affected by waste discharges. The findings presented, largely in tabular form, are based on limited data and represent the conditions at the time of sampling only.

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PRELIMINARY INVESTIGATION OF SELECTED WATER QUALITY CONDITIONS IN THE LOWER COLORADO RIVER

PARKER DAM TO MORELOS DAM AND MEXICAN CANAL SYSTEM

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
BUREAU OF STATE SERVICES
DIVISION OF WATER SUPPLY AND POLLUTION CONTROL
REGION VIII
DENVER, COLORADO

COLORADO RIVER BASIN WATER QUALITY CONTROL PROJECT

OCTOBER 1963

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U. S. Geological Survey

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PRELIMINARY INVESTIGATION OF SELECTED WATER QUALITY CONDITIONS IN THE LOWER COLORADO RIVER- PARKER DAM TO MORELOS DAM AND MEXICAN CANAL SYSTEM

by

C. Henderson and A. D. Sidio[1/]

INTRODUCTION

This report covers a reconnaissance survey conducted on the Lower Colorado River during July 1961.

The purpose of the survey was to investigate water quality conditions in the Lower Colorado River, to determine if any sections of the river were significantly affected by waste discharges, and to determine needs for more complete investigations.

The survey was conducted jointly by the Colorado River Basin Project and the Field Operations Section of the Robert A. Taft Sanitary Engineering Center. Personnel participating in the field survey were C. Henderson and P. A. Fichter, Biologists from the Colorado River Basin Project; A. D. Sidio, Engineer, L. Resi, Bacteriologist, and T. Newman, Sample Collector, from the Robert A. Taft Sanitary Engineering Center; and W. C. Gilbert, Engineer from the Arizona Department of Health.

The Field Operations Section of the Robert A. Taft Sanitary Engineering Center had recently equipped a small mobile laboratory for pollutional reconnaissance surveys. As laboratory facilities were not yet available for the Colorado River Basin Project, it was felt that this was an opportune time to conduct this joint survey. A previous short term study had shown adverse water quality conditions in the Yuma area, which led to selection of this area for further study (1).

The study covered a two-week period. During the first week, July 11-17, 1961 inclusive, the section of the river from Havasu Lake to below Palo Verde Lagoon was covered. During the second week, July 19-25, 1961 inclusive, the section from above Imperial Dam to the International Border below Yuma, Arizona was covered as well as portions of the Mexican Canal system. The area studied in Mexico extended from Morelos Dam to the Mexicali water supply intake, and the Sanchez-Mejorada Canal from the lift station at San Luis, Arizona to approximately twelve miles below San Luis, Sonora. Maps of these areas with the locations of the sampling stations are shown in Figures 1 and 2.

The findings presented here are based on limited data and represent the conditions at the time of sampling only.

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SAMPLING STATIONS FROM
PARKER DAM TO PALO VERDE
JULY 11-25, 1961

COLORADO RIVER BASIN
WATER QUALITY CONTROL PROJECT
DEPT. OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION VIII DENVER, COLORADO

FIGURE 1

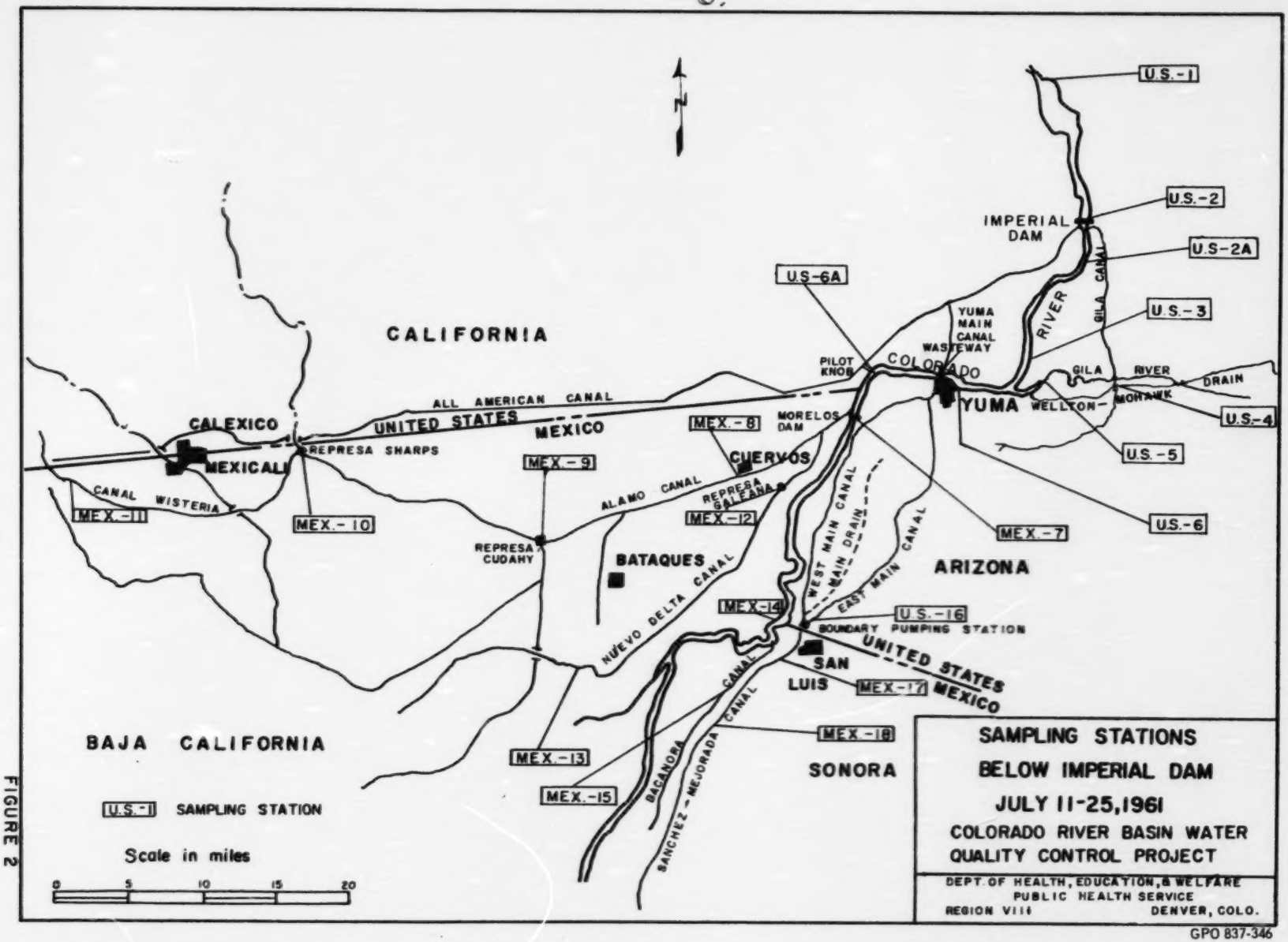

FIGURE 2

GPO 837-346

SUMMARY AND CONCLUSIONS

Limited water quality investigations were carried out on the lower Colorado River during the period July 11-25, 1961. Studies covered the section of the river from Parker Dam downstream to the United States-Mexico border and also included parts of the Mexican Canal system.

During the period of the survey, the section of the river from Parker Dam to Imperial Dam was not greatly affected by wastes and irrigation return waters entering the river.

Coliform bacteria densities increased to a maximum of 820 coliforms per 100 ml. in the area below Parker, Arizona. However, the full effects of the recreational uses of the stream are not indicated by the results obtained because of the time of the study. Major recreational use occurs during the spring and fall periods and is concentrated mainly in the Parker Dam to Parker area. More extensive studies should be conducted in this area during the major recreational season with special emphasis on possible bacterial contamination and possible effects from extensive use of outboard motors.

In the above area, certain water quality characteristics such as turbidity, specific conductance, hardness and chlorides increased to a slight extent progressively downstream, possibly from irrigation return waters entering the river from the Colorado River Indian Reservation and Palo Verde Irrigation District. New land is being developed and drainage wells and canals constructed in both of these irrigation projects. Surveillance should be maintained on irrigation returns from these projects and their possible effects on the Colorado River.

Biologically, the river does not change significantly in the section from Parker Dam to Imperial Dam. The natural shifting sand bottom throughout most of this section discourages production of bottom animals and they are abundant only in a few rocky, riffle areas. Plankton numbers increase somewhat downstream probably due to increased nutrients from irrigation returns. Waste sources apparently have no serious detrimental effect on bottom organisms or fish. The Asiatic clam, Corbicula fluminea, is present in large numbers throughout the area studied and may have a clogging effect on irrigation and domestic water distribution systems.

The major waste discharges which may have detrimental effects on the lower Colorado River occur in the section of the river from Imperial Dam to the Mexican border.

Sediment returned to the river from the All-American Canal desilting basins increases turbidity and chokes the river channel with silt and sand in the reach between Imperial and Morelos Dams. This is believed to be the primary cause for the change in fish population from game species such as bass and sunfish to less desirable rough species such as carp and mullet. High water temperatures and changes in other water characteristics such as salinity may also contribute to this population change.

Bacteriologically, the river is degraded upon the entrance of raw sewage from Yuma. An average density of over 17,000 coliforms per 100 ml. was found at Morelos Dam and as high as 25,000 in the Mexican Canal system.

Chemical degradation of the river occurs below the entrance of the Gila River which contains mostly irrigation return waters. Such characteristics as specific conductance, hardness, chlorides and sulfates are considerably above generally accepted standards for domestic water use. The degraded quality continues into Mexico throughout the canal system.

Because of the limited nature of the studies, more conclusive interpretation of the data is not possible. The data collected indicate that pollution does exist and that additional studies are needed for a more complete analysis of the effects of wastes and return irrigation waters on the Colorado River.

GEOGRAPHICAL DESCRIPTION OF AREA

The section of the Colorado River covered by this study is the southernmost 200 miles of the river in the United States. This section of the river serves as a boundary between Arizona and California from above Parker Dam to just above Morelos Dam and as the International Boundary between Arizona and Mexico for the last 20 miles (Figures 1 and 2).

The land area along the river includes several wide, flat, fertile, flood plains and benches which when irrigated produce high yields of agricultural crops. The remainder of the area is rolling to mountainous semiarid desert country covered with sparse vegetation such as sagebrush, greasewood, salt cedar and cactus. These lands contribute little to the economy of the area. The elevation ranges from about 130 feet above sea level at Yuma to 450 feet at Havasu Lake.

The economy is based principally on irrigated agricultural land and recreation. There is little industrial development in the area. The bright sunshine, warm winters and scant annual rainfall (3 inches at Yuma) contribute greatly to increasing recreational development.

Major agricultural and resort centers are Yuma and Parker, Arizona and Blythe, California with a combined population of some 35,000 people. Other populated areas are irrigated portions of the Colorado River Indian Reservation, several other irrigation projects and an army installation, the Yuma Test Station. The remainder of the area is very sparsely populated.

Two major east-west highways cross the area, one at Blythe, California and the other at Yuma, Arizona. One major north-south highway parallels a portion of the river between Parker, Arizona and Blythe, California. A state highway connects Parker and Yuma. Much of the remaining area is inaccessible except by poor unpaved roads.

The Colorado River is largely controlled and regulated by Hoover and Davis Dams upstream from the study area covered in this report.

WATER USES AND POTENTIAL SOURCES OF POLLUTION

With the exception of water withdrawn for the Metropolitan Water District of Southern California Aqueduct and the city of Yuma domestic supply, the river in the United States is used almost entirely for agricultural and recreational purposes. Cotton and alfalfa are the major crops grown on irrigated lands throughout the area. Some vegetables, citrus fruits, grasses and grains are also grown and a number of large cattle feed lots are operated. In accessible sections, the river is used extensively for recreation and this use is expanding rapidly. In Mexico, the waters are used primarily for irrigation, domestic supplies and recreation.

The following sections are narrative descriptions of the two study areas describing river conditions, water uses and potential sources of pollution progressively downstream. Flow figures for irrigation canals were obtained from the U. S. Geological Survey and represent flows in the canals during the period of this investigation (2). Populations of cities and towns are 1960 census figures (3). Irrigation project acreages are taken from U. S. Bureau of Reclamation or Irrigation District brochures (4, 5).

Parker Survey Area

One of the primary functions of Parker Dam, 155 miles below Hoover Dam, is to serve as a forebay for the Metropolitan Water District of Southern California Aqueduct which supplies municipal and industrial water to southern California. The aqueduct intake is located approximately two miles upstream from Parker Dam (Station 1). Approximately 800 million gallons of water per day are furnished to some 85 communities comprising over 8 million people in southern California (6). Parker Dam is designed for power production and power in excess of that used by the Metropolitan Water District goes into the southwest power pool (7).

The impoundment behind Parker Dam is the clear, blue Havasu Lake, about 45 miles long and 75 feet deep which covers approximately 25,000 acres. It is used fairly extensively for water sports, including fishing, swimming, boating and water skiing. Facilities for public use, including campgrounds, trailer parks, cabins and boat docks, are located at several points along the lake.

The river below Parker Dam is clear and fast flowing with a rocky bottom and scattered sandy beaches. The reach between Parker Dam and Headgate Rock Dam is used intensively for recreational purposes. Boat docks, camps, cabins, lodges and homes line the river on both the Arizona and California sides. It is estimated that over 30,000 people use this stretch of river on some holidays and weekends.

Headgate Rock Dam (Station 3) just above Parker, Arizona serves to divert 880 cfs of irrigation water to the Colorado River Indian Reservation which contains 105,000 acres of irrigable land with 40,000 acres in cultivation. Irrigation drains from this project enter the Colorado River at several points (Stations 5, 8, and 9). New land and outlet drains are currently being developed.

The town of Parker, Arizona, with a resident population of 1,600 and a large tourist influx, obtains domestic water from wells and uses septic tanks for sewage disposal.

The section of the river from Parker to Palo Verde Diversion Dam (Station 7) is clear, somewhat less rapid than above and with almost entirely a sand bottom. The river on the Arizona side is in the Colorado River Indian Reservation, is not readily accessible to the public, and has limited recreational use by the Indians. On the California side which is accessible by a good highway, there are a number of fishing camps and boat docks with fairly extensive use for water sports.

The Palo Verde Dam diverts 1,840 cfs of water to the Palo Verde Irrigation District near Blythe, California, which contains 120,000 irrigable acres with 80,000 in cultivation. Irrigation returns from this project drain into the Palo Verde lagoon (Station 13) which enters the Colorado River above Station 14. New land and irrigation drains are also being developed in this project. The town of Blythe with a population of 6,000 obtains municipal water from wells and disposes of sewage by percolation and evaporation.

The section of the river from Blythe to the lower end of the Cibola Valley (Station 14) has scattered fishing camps and boat docks in accessible areas on both sides of the river. Water is pumped directly from the river to irrigate a few farms in the Cibola Valley which has possibilities for future increased agricultural development.

Potential pollution sources in the Parker survey section of the river are: (1) Bacterial contamination from recreational areas, (2) motor exhaust from intensively used boating areas, and (3) irrigation drains from the Colorado River Indian Reservation and Palo Verde Irrigation District.

Yuma Survey Area

Imperial Reservoir is a clear, wide, shallow impoundment with numerous sloughs, lakes and swamps, located about 18 miles upstream from Yuma, Arizona. It is used to a considerable extent for water sports including swimming, fishing, boating and water-fowl hunting. A number of fishing camps, trailer camps and boat docks are located on its shores. Most of the area is managed by the U. S. Fish and Wildlife Service as a National Wildlife Refuge.

Imperial Dam serves to divert irrigation water into the All-American Canal on the California side and the Gila Canal on the Arizona side of the river. The All-American Canal, with a flow of 9,830 cfs., furnishes water to approximately 575,000 acres of land in the Imperial and Coachella Valleys of California and to about 60,000 acres in the Yuma Project in Arizona and California. Desilting basins at Imperial Dam return silt and sand from the All-American Canal waters to the Colorado River which has a flow of about 750 cfs. remaining below the dam. Little, if any, irrigation return flow from the California side enters the river above Yuma. The Gila Canal, with a flow of 1,680 cfs., furnishes water to about 53,000 acres of land presently

under irrigation in the Wellton-Mohawk Division and to about 25,000 acres under irrigation in other Gila irrigation project units. Return drains from these projects enter the Gila River which flows (approximately 300 cfs.) into the Colorado River several miles above Yuma.

Until late 1960[1/], Yuma, with an estimated peak usage of approximately 16 million gallons per day, obtained all of its domestic water supply directly from the Colorado River (8). Primarily because of high chlorides, alternative arrangements were made to obtain water from the Yuma Main Canal which originates above Imperial Dam. Raw sewage from Yuma enters the river about four miles above Morelos Dam located just below the California-Mexico border. Additional water from the Yuma Main Canal wasteway (940 cfs.) and the Pilot Knob return (1285 cfs.) enters the river between Yuma and Morelos Dam.

The river between Imperial and Morelos Dams is turbid and carries a large suspended solids load. The river bed is almost entirely shifting sand with many visible sand bars. Very little recreational use is made of this section of the river.

Potential pollutional sources in the Yuma area are: (1) Irrigation drains, which increase chlorides, hardness, and solids, which may add nutrients and increase plankton growths, and which may contain toxic pesticides; (2) raw sewage from Yuma which may cause oxygen depletion may produce bacterial contamination and which may also contain nutrients and detergents; (3) the All-American desilting basin which adds large quantities of silt and sand to the relatively small remaining flow in the Colorado River.

The 3,400 cfs. flow of the Colorado River at Morelos Dam is almost entirely diverted into an irrigation canal system in Mexico. While the major use of this water is for irrigating crops, mainly cotton, it is also used for other purposes. The city of Mexicali, with a population of 170,000, uses a branch of the Alamo Canal (Station Mex.-11) as a municipal water supply. Many homes are located near the canals and the canal waters are used to a considerable extent for domestic and recreational purposes.

The main drain from the Yuma project (Station U.S.-16) is pumped into Mexico at San Luis to originate the Sanchez Mejorada irrigation canal. The Bacanora Canal in Mexico originates from irrigation return waters and seepage which enters the Colorado River channel below San Luis.

SAMPLING

Sampling stations were established as shown numerically in Figures 1 and 2 as described in Table I. River mileages shown are measured upstream from where the Colorado River crosses the Arizona-Sonora border and which is the

1/ Yuma started using a third of its domestic supply from the Yuma Canal in September 1960 but it was not until February 1961 that all use of Colorado River water was discontinued (6).

TABLE I

Description of Sampling Stations Shown in Figure 1

Parker Area - July 11-17, 1961

No. 1	(C 200) Metropolitan Aqueduct Intake (Approximately 2 miles above Parker Dam)
No. 1A-S	(C 198) Face of Parker Dam - surface sample
No. 1A-D	(C 198) Face of Parker Dam - 100 ft. depth sample
No. 1B	(C 197) One-fourth mile below Parker Dam
No. 2	(C 192) Approximately 6 miles below Parker Dam
No. 3	(C 184) Headgate Rock Dam
No. 4	(C 181) Colorado Indian Reservation Landing at Parker, Arizona
No. 4A	(C 173) Immediately above Colorado River Indian Reservation Drain
No. 5	(C 173 IR 1) Irrigation Return Canal west of Poston Garage - at Old Boy Scout Camp
No. 6	(C 161) Indian Camp Ground Approximately 3-1/2 miles south on Highway from Poston Grade School and 3-1/2 miles west to river
No. 7	(C 150) Palo Verde Diversion Dam
No. 8	(C 149.5 IR 0.5) Irrigation Return Ditch Approximately 1/2 mile east of Palo Verde Diversion Dam
No. 9	(C 149 IR 1) Irrigation Return Ditch Approximately 1-1/2 miles east of Palo Verde Diversion Dam
No. 10	(C 125) Blythe Bridge
No. 11	(C 91) Cibola Bridge
No. 12	(C 84 IR 7) Palo Verde Lagoon Bridge South of Palo Verde, California - this station was above last irrigation return ditch

No. 13	(C 84 IR 2) Palo Verde Lagoon Approximately 2 miles above confluence with Colorado River. Below all irrigation return ditches
No. 14	(C 75) Cibola Landing and Walter's Camp

Description of Sampling Stations Shown in Figure 2

Yuma Area - July 19-25, 1961

No. U.S.-1	(C 51) Fisher's Landing above Imperial Dam
No. U.S.-2	(C 43) Imperial Dam
No. U.S.-2A	(C 39) Colorado River below Laguna Dam
No. U.S.-3	(C 36) Colorado River above mouth of the Gila River
No. U.S.-4	(C 37 Gi 4 IR 4) Wellton-Mohawk Drain 1 mile below Highway 95
No. U.S.-5	(C 37 Gi 1) Mouth of Gila River
No. U.S.-6	(C 32) Colorado River at Yuma, Arizona water intake
No. U.S.-6A	(C 26) Colorado River above Pilot Knob return
No. Mex.-7	(C 23) Colorado River at Morelos Dam
No. Mex.-8	(C 23 AC 10) Alamo Canal at Cuervos

No. Mex.-9	(C 23 AC 27) Alamo Canal at Represa Cudahy
No. Mex.-10	(C 23 AC 45) Alamo Canal at Represa Sharps - approximately 4 miles east of Mexicali
No. Mex.-11	(C 23 WC 49) Wisteria Canal Mexicali water supply intake
No. Mex.-12	(C 23 NDC 9) Nuevo Delta Canal at Represa Galeana
No. Mex.-13	(C 23 NDC 9) Nuevo Delta Canal approximately 6.3 miles south of Bataques
No. Mex.-14	(C 0) Colorado River Bridge at San Luis
No. Mex.-15	(C 3 BC3) Bacanora Canal approximately 14 miles south of Represa Galeana and about 8 miles south of San Luis
No. U.S.-16	(SMC 0) Sanchez Mejorada U. S. side of fence at San Luis boundary pumping station
No. Mex.-17	(SMC 4) Sanchez Mejorada 3.84 miles south of San Luis
No. Mex.-18	(SMC 12) Sanchez Mejorada 12 miles south of San Luis

southernmost point of the Colorado River in the United States (9).

Grab samples were collected once a day for seven consecutive days at each of the stations for bacteriological determinations, temperatures and dissolved oxygen. Analyses were made for turbidity, specific conductance, pH, alkalinity and hardness once or more at each station. The above analyses were performed in the mobile laboratory or with a field chemical kit on location in the study area. A one-gallon water sample was collected at each station and sent to a mobile field laboratory at Durango, Colorado for calcium, magnesium, chloride, sulfate and phosphate analyses. Biological samples for plankton and bottom animals were collected once at each station, preserved, and returned to the Salt Lake City laboratory for sorting and identification.

On August 16, 1961, additional water samples were collected at selected points in the Yuma area and sent to the Robert A. Taft Sanitary Engineering Center for bacterial survival tests.

STREAM FLOWS

Streamflow data are given in Table II and Appendix A. These data for Colorado River stations and major irrigation diversions were obtained from the U. S. Geological Survey offices at Yuma, Arizona. Where sampling stations did not coincide with USGS gauges, the flow was estimated by difference between known flows taking into consideration withdrawals and returns to the river in the interim stretches.

Flow data for irrigation drains were obtained from the Colorado River Indian Agency and the Palo Verde Irrigation District. Flow in the Gila River was obtained by difference from USGS data below Imperial Dam and at Yuma. Flows in the Wellton-Mohawk Canal and in the Colorado River at the San Luis bridge were measured in the field. Flow at Morelos Dam and in the Mexican canals was obtained from the Mexican Section, International Boundary and Water Commission.

Where daily flows are given in the appendix, the values were taken directly from gauge readings. Where only a single value is given, it represents an estimated average value for the period during which the survey was conducted.

DISCUSSION OF SURVEY DATA

Data on coliform group bacteria, biological and limited chemical data were collected from Parker Dam to the Cibola Valley area from July 11-17, 1961. The study was continued from above Imperial Dam into Mexico during the period July 19-25, 1961.

Bacteriological Data

Determinations for coliform bacteria by the membrane filter technique (9) were made daily at each of the sampling stations. Average results obtained are recorded in Table II. Results on individual samples are recorded in Appendix A.

TABLE II

Analytical Results

Average for Survey Period

Station Number	River Miles	Temp. °C.	D.O. mg/l	Percent Saturation	Coliform per 100 ml	Flow cfs	Cond. µ mhos	Turbidity mg/l	pH	Alk. mg/l $CaCO_3$	Hardness mg/l $CaCO_3$
Parker Survey Area - July 11-17, 1961 Data											
1	C 200	28	8.9	112	29	-	1,100	< 7	8.1	110	365
1A-S	C 198	30	8.6	113	--	-	1,100	< 7	8.1	128	330
1A-D	C 198	25.5	5.2	63	--	-	1,100	-	7.4	108	385
1B	C 197	25.5	7.2	87	--	-	1,025	< 7	7.7	126	350
2	C 192	25	7.8	93	52	14,600	1,050	11	7.8	126	350
3	C 184	24	7.4	87	139	-	1,100	< 7	8.0	124	346
4	C 181	25	9.3	111	820	13,700	1,000	< 7	8.1	140	380
4A	C 173	24.5	8.0	96	--	-	1,000	< 7	8.0	130	360
5	C 173 IR 1	27	7.8	96	330	19	1,100	22	8.1	130	365
6	C 161	27	7.9	97	630	-	1,000	9	8.1	122	360
7	C 150	27	7.7	95	610	11,260	1,050	-	-	130	335
8	C 149.5 IR0.5	28	8.9	113	780	32	1,200	< 7	8.4	150	390
9	C 149 IR 1	25	7.3	87	1,330	265	2,600	50	8.5	212	715
10	C 125	28	7.7	97	160	11,200	1,000	16	8.1	134	366
11	C 91	28	7.1	90	300	12,000	1,100	17	8.1	131	375
12	C 84 IR 7	30	5.2	68	700	-	2,300	--	7.7	260	575
13	C 84 IR 2	28	5.9	75	960	800	2,600	70	7.7	260	550
14	C 75	28	7.0	89	220	12,500	1,100	19	8.0	143	377
Yuma Survey Area - July 19-25, 1961 Data											
U.S.-1	C 51	29	7.2	92	160	12,500	1,150	19	8.2	135	372
U.S.-2	C 43	30	7.1	93	225	-	1,150	19	8.1	136	363
U.S.-2A	C 39	31	7.0	94	-	-	1,200	48	8.0	136	360
U.S.-3	C 36	30	6.9	91	450	-	1,250	26	8.1	143	385

TABLE II (CONTINUED)

Analytical Results
Average for Survey Period

Station Number	River Miles	Temp. °C	D.O. mg/l	Percent Saturation	Coliform per 100 ml	Flow cfs	Cond. µ mhos	Turbidity mg/l	pH	Alk. mg/l $CaCO_3$	Hardness mg/l $CaCO_3$
U.S.-4	C37 Gi 4 IR 4	27	8.0	99	270	-	9,500	38	7.7	270	2,430
U.S.-5	C37 Gi 1	29	6.8	87	300	-	9,500	50	7.7	252	2,250
U.S.-6	C32	32	7.5	103	240	1,070	3,300	37	8.0	185	848
U.S.-6A	C26	33	7.2	99	---	-	2,200	35	8.1	156	600
Mex.-7	C23	31	7.0	93	17,000	3,400	1,900	35	8.1	149	535
Mex.-8	C23AC10	31	6.9	92	25,600	2,010	1,725	--	8.0	144	492
Mex.-9	C23AC27	30	7.1	93	4,500	520	1,775	25	8.1	157	505
Mex.-10	C23AC45	32	5.8	80	500	102	1,750	35	7.8	136	490
Mex.-11	C23WC49	30	4.6	61	2,700	7.4	1,700	38	7.6	139	480
Mex.-12	C23NDC 9	31	7.2	96	21,800	1,140	1,775	--	8.0	148	503
Mex.-13	C23NDC 26	32	9.6	130	420	64	1,775	24	8.1	154	495
Mex.-14	C 0	32	8.1	111	750	-	1,550	--	8.0	131	458
Mex.-15	C 3 BC 3	31	7.1	95	1,400	338	1,750	38	7.9	152	515
U.S.-16	SMC 0	29	5.6	72	5,000	-	2,500	50	7.8	232	662
Mex.-17	SMC 4	29	5.8	74	6,300	190	2,450	50	7.7	222	638
Mex.-18	SMC 12	30	6.1	80	3,900	129	2,300	75	7.8	215	613

(1) C - Denotes Colorado River sampling points
IR - " irrigation returns
Gi - " Gila River
AC - " Alamo Canal
WC - " Wisteria Canal
NDC - " New Delta Canal
BC - " Bacanora Canal
SMC - " Sanchez Mejorada Canal

(2) Prefix of U.S. or Mex. with July 19-25 dates indicates samples were collected in the U.S. or Mexico

(3) Mileages in Mexican canals measured downstream from Morelos Dam or from point of origin

Relatively low numbers of coliform bacteria were present in the river from Parker Dam to the Cibola Valley. Some increases occurred below sources of domestic wastes and irrigation return waters. The maximum average count, 820 coliforms per 100 ml. in the Parker survey area, was below Parker, Arizona (Station 4), which probably reflects the extensive recreational use of the river between Parker Dam and Parker. Coliform values were slightly higher in some irrigation drains than in the main river.

Above Yuma, coliform densities were relatively low ranging from 160 to 450 coliforms per 100 ml. Below Yuma, coliform densities were increased substantially due to the discharge of raw sewage, reaching an average of 17,400 coliforms per 100 ml. at Morelos Dam (Station Mex.-7). The peak average density of 25,600 coliforms per 100 ml. was found in the Alamo Canal at Cuevos, Mexico (Station Mex.-8). Some other values in Mexican canals were also high.

Though coliform densities were high, they were much lower than some previously reported values (11) and also below what may be expected from the raw sewage at Yuma. Calculations based on a flow of 3,400 cfs. at Morelos Dam and a sewered population of 17,500 would indicate an expected maximum density of 84,000 coliform per 100 ml. at the peak of the coliform growth curve.

Because of the relatively low densities of coliforms found during the July 1961 survey as compared with previous findings and calculated values, it was believed that some inhibitory agent may be affecting the coliform growth curve. On August 16, 1961, samples were collected in the Yuma area and sent to the Robert A. Taft Sanitary Engineering Center for bacterial survival tests[1/]. The results of these tests are recorded in Table III. The results show relative inhibition of growth in minimal synthetic medium, particularly at Morelos Dam and in the Alamo Canal at Represa Cudahy. These two points are well below the Yuma sewage discharge and are in locations where maximum coliform densities may be expected.

In order to further substantiate these findings and possibly ascertain the reason, further bacteriological work is needed in the Yuma area. It would also be desirable to obtain more data on bacteriological quality in both the Parker and Yuma areas during the major recreational and resort seasons.

1/ The bacterial survival test, described in Standard Methods for the Examination of Dairy Products, 11th Edition, American Public Health Assoc., Inc., 1960, p. 61, measures inhibitory substances in water by comparing the growth of a pure culture of Aerobacter aerogenes in the unknown water sample to that in a pure redistilled water used as a control. The sample and control are pre-sterilized by membrane filtration and fortified with chemically defined minimal growth constituents. The presence of a toxic agent is indicated by a decrease of 20 percent or more in the 24 hour population compared to the control.

TABLE III

Bacterial Survival Tests

August 16, 1962

YUMA		Station	Inhibition Index
T 1	Gila River (Just above Mouth, includes Wellton-Mohawk Dr.)	5	1.450
T 2	Colorado River (Above confluence of Gila R.)	3	0.743
T 3	California Wasteway (Between All-American Canal and Colorado River)		0.409
T 4	Morelos Dam Bridge	7	0.288
T 5	Represa Cudahy	9	0.375
T 6	Intake at Mexicali	11	0.813
T 7	Bacanora Canal (Below San Luis)	15	1.175

Interpretation:

1.200 or higher - stimulation of growth in minimal synthetic medium

0.800 - 1.200 - indeterminate range

0.800 or less - relative inhibition of growth in minimal synthetic medium

Physical and Chemical Data

Analyses for dissolved oxygen and temperature were made daily at each station during the survey periods. Average results are recorded in Table II and results on individual samples are recorded in Appendix A. All analyses were conducted by Standard Methods (9).

The dissolved oxygen in the upper reach studies was at or near saturation values in the surface waters with the lowest concentration near 7.0 mg/1. However, there was a decrease to 5 mg/1 in the deeper waters of Havasu Lake (Station 1A-D). Dissolved oxygen values in irrigation returns were somewhat lower than at main river stations but apparently caused no decrease in the river waters below. Dissolved oxygen content of the river below Yuma was not materially affected by the sewage discharge. Minimum values were slightly less than 7.0 mg/1. On the Mexican Canal system one average value of less than 5.0 mg/1 occurred at the Mexicali water supply intake which probably reflects increased organic loadings in the canal system.

Throughout the reach of river studied, water temperatures were generally within ranges (24-32°C) considered satisfactory for the support of warm water game species of fish but were somewhat above levels usually considered favorable for trout. Several higher readings (maximum 35°C) were recorded in the Yuma vicinity, which are approaching levels usually considered unsatisfactory for fish support.

Analyses for turbidity, specific conductance, pH, alkalinity, and hardness were made in the field from one to four times at each station during the survey periods. Average results are shown in Table II and results of individual samples in Appendix B.

The river in the upper reaches of the Parker survey area was very clear (turbidity <7 mg/1) between Parker Dam (Station 1A) and Palo Verde Dam (Station 7). Below this point, the river was somewhat more turbid (16-22 mg/1), probably the result of the entrance of the more turbid irrigation returns from the Colorado River Indian Reservation and Palo Verde Irrigation District as well as natural erosion from the river banks and channel.

Below Imperial Dam the turbidity increased sharply, reflecting the return of sediment from the All-American desilting basins. The river remained somewhat turbid downriver to Morelos Dam and also in the canal systems. The pH values remained fairly uniform (8.0 - 8.2) throughout the whole study area with slightly lower values (7.4 - 8.0) in the irrigation returns and in the Mexican canals. Alkalinity increased to some extent progressively downstream and was considerably higher in irrigation returns and in the Mexican canals.

Specific conductance and hardness did not increase appreciably from Parker Dam to a point (U.S.-3) above the confluence with the Gila River. Below the Gila River, which includes the drain from the Wellton-Mohawk irrigation project, both conductivity and hardness increased sharply. Average readings at the Yuma water plant (Station U.S.-6) were 3300μ mhos conductance and 848 mg/1 hardness.

In order to determine the distribution of salts across the river channel, samples were taken at intervals across the river just above the Yuma water treatment plant (Station U.S.-6). Following the specific conductance readings and distances from the Arizona shore for samples taken at 4:30 p.m., July 22, 1961.

Dist. from Shore (ft.)	Sp. Cond. μ mhos	Dist. from Shore (ft.)	Sp. Cond. μ mhos
10	3300	115	3000
20	3100	220	3300
30	3100	240	3000
40	3300	250	3300
50	3000	275	3300
75	2800	300*	3300
100	3000		

* 25 ft. from California shore

These data indicate that the salt distribution across the river at this point was fairly uniform.

One-gallon water samples were collected once at each sampling station and sent to a field laboratory at Durango, Colorado for further chemical analyses including calcium, magnesium, chlorides, sulfates, and phosphates. The results of these analyses are shown in Table IV.

The results of chemical analyses indicate that the river does not deteriorate greatly in chemical quality from Parker Dam to the confluence with the Gila River. The chemical quality was generally degraded below this point with large increases in conductivity, hardness and chlorides. The degraded chemical quality continued downriver and throughout the Mexican Canal system.

Biological Data

Plankton and bottom animal samples were collected at each main river station and in some irrigation canals. Observations were made with respect to fish populations, fishing, and other recreational use.

A. Plankton:

One-gallon composite surface water samples were collected for plankton analysis. Samples were preserved with 5 percent formalin and returned to the laboratory. Plankton organisms were concentrated from one to two liters

TABLE IV

Analytical Results[1/]

Single Samples

Location (Sta. No.)	Date Collected	mg/l $CaCO_3$ Alkalinity	mg/l $CaCO_3$ Hardness	Ca mg/l	Mg mg/l	Cl mg/l	SO_4 mg/l	PO_4 mg/l
Parker Survey Area - July 11-17, 1961								
Lake Havasu - Metropolitan Water District Intake (Sta.1)	7-16	113	320	77	31	82	260	<0.1
Colo. River - 6 miles below Parker Dam (Sta. 2)	7-16	124	331	80	32	80	250	<0.1
Colo. River - Headgate Rock Dam (Sta. 3)	7-16	125	331	81	31	85	260	<0.1
Colo. River - Indian Reservation Dock (Sta. 4)	7-15	148	279	78	20	85	250	<0.1
Drain - Old Boy Scout Camp (Sta. 5)	7-15	128	340	84	32	85	260	<0.1
Colo. River above Station 5 drain (Sta. 4A)	7-15	124	328	82	30	92	250	<0.1
Colo. River at Indian Camp Ground (Sta. 6)	7-15	125	329	81	31	80	250	<0.1
Colo. River above Palo Verde Div. Dam (Sta. 7)	7-15	123	278	81	18	59	260	<0.1
Drain near Dam-West Drain (Sta. 8)	7-15	143	360	85	36	85	290	0.15

TABLE IV (CONTINUED)

Analytical Results

Single Samples

Location (Sta. No.)	Date Collected	mg/l $CaCO_3$ Alkalinity	mg/l $CaCO_3$ Hardness	Ca mg/l	Mg mg/l	Cl mg/l	SO_4 mg/l	PO_4 mg/l
Drain near Dam - East Drain (Sta. 9)	7-15	215	656	166	59	390	550	0.19
Colo. River at Blythe Bridge (Sta. 10)	7-14	129	337	82	32	80	270	<0.1
Colo. River - Cibola Br. (Sta. 11)	7-14	130	342	83	33	85	250	<0.1
Palo Verde Lagoon - 2 miles above mouth (Sta. 13)	7-13	238	506	128	45	440	470	0.14
Colo. River below Cibola Valley (USGS) (Sta. 14)	7-13	180	396	86	44	110	280	<0.1
		Yuma Survey Area - July 19-25, 1961						
Colo. River at Fisher's Landing (U.S.-1)	7-21	130	350	89	31	105	290	<0.1
Colo. River at face of Imperial Dam (U.S.-2)	7-21	130	356	89	32	105	300	<0.1
Colo. River below Laguna Dam (U.S.-2A)	7-22	133	351	87	32	105	300	<0.1
Colo. River above mouth of Gila River (U.S.-3)	7-23	-	-	-	-	145	-	-

TABLE IV (CONTINUED)

Analytical Results

Single Samples

Location (Sta. No.)	Date Collected	mg/l $CaCO_3$ Alkalinity	mg/ $CaCO_3$ Hardness	Ca mg/l	Mg mg/l	Cl mg/l	SO_4 mg/l	PO_4 mg/l
Welton-Mohawk Drain - 1 mi. below Hsy. 95 (U.S.-4)	7-21	270	2,230	512	231	2,800	980	<0.1
Gila River - 1 mi, above mouth (U.S.-5)	7-21	240	2,080	464	224	2,580	930	0.14
Colo. River at Yuma Water Intake (U.S.-6)	7-22	168	790	187	78	755	470	<0.1
Colo. River above Pilot Knob wasteway (U.S.-6A)	7-22	155	565	136	55	416	350	<0.1
Colo. River at Morelos Dam (Mex.-7)	7-22	155	547	133	52	377	350	<0.1
Colo. River at Mexican Border (Mex.-14)	7-24	125	377	92	36	150	290	<0.1
Alamo Canal near Cuervos (Mex.-8)	7-23	145	476	116	45	280	330	<0.1
Alamo Canal below Bataques (Mex.-9)	7-23	148	486	124	43	290	350	<0.1
Wisteria Canal at Mexicali Water Intake (Mex.-11)	7-23	135	477	117	45	280	350	<0.1

TABLE IV (CONTINUED)

Analytical Results

Single Samples

Location (Sta. No.)	Date Collected	mg/l $CaCO_3$ Alkalinity	mg/l $CaCO_3$ Hardness	Ca mg/l	Mg mg/l	Cl mg/l	SO_4 mg/l	PO_4 mg/l
New Delta Canal at Represa Galena (Mex.-12)	7-23	145	473	114	46	285	350	<0.1
New Delta Canal - 6 mi. below Bataques (Mex.-13)	7-23	133	477	117	45	300	340	<0.1
Yuma Canal at border pumping station (U.S.-16)	7-24	248	615	161	52	430	430	0.19

1/ Analyses by Colorado River Project Laboratory at Durango, Colorado

with a Foerst continuous centrifuge. Survey and strip counts were made in a Sedwick-Rafter counting cell and major types identified to Genus. A summary of plankton results is shown in Tables Va and Vb.

The plankton population of the river consisted of moderate numbers of a large variety of organisms. Diatoms were predominant in the phytoplankton population with Navicula, Synedra, Cocconeis and Cymbella the dominant types. Greens were also fairly abundant, especially at lower stations with Scenedesmus, Ankistrodesmus and Closterium dominant types. Some bluegreens, mostly Anacystis and Oscillatoria, and pigmented flagellates, mostly Euglena, Peridinum and Dinobryon, were present at most stations.

The zooplankton population was apparently quite sparse at most river stations but the data obtained were so sketchy that no interpretation was attempted.

Interpretation of a single set of plankton data is quite difficult, especially when taken in midsummer when organisms are usually present in minimum numbers. There was an apparent increase in phytoplankton downstream from Parker Dam to the Cibola Valley. While numbers of plankters in irrigation drains from the Colorado River Indian Reservation and Palo Verde Irrigation District were fairly low, nutrients from these drains may have contributed to increased numbers in the river below.

Phytoplankton counts in Imperial Reservoir were fairly low but increased considerably at Laguna Dam. This probably reflects the return of organisms along with silt from the desilting basins to a considerably less volume of water. Counts were also high in the Wellton-Mohawk drain and in the Gila River. The high salt content of these waters apparently has no detrimental effect on plankton organisms.

Phytoplankton counts remained high at the Yuma water intake but dropped considerably downriver from this point and in the Mexican canals, probably due to increased dilution. Green algal forms were more abundant at the lower stations. Sewage entering the river below Yuma apparently had little effect on phytoplankton.

Before much significance can be attached to plankton data and proper interpretation made, it will be necessary to collect periodic samples over a longer period of time, possibly a year or more.

B. Bottom Animals:

As a large part of the river bottom in the survey area was composed of shifting sand and was relatively infertile containing few if any organisms, it was necessary to carefully select bottom animal sampling stations where populations could be found. Where possible, one square foot riffle samples were collected with a Surber sampler. These samples were taken in shallow (12"-18") fast water usually at protruding rocky points or at ends of islands. Such areas would be expected to be the most productive parts of the river bottom. Where such area were not available, bottom samples were collected in

TABLE Va

Plankton - Parker Area
July 11-17, 1961

Station	Date	Time	Phytoplankton Number Organisms per Milliliter					Zooplankton Organisms per Liter
			Diatoms	Greens	Blue-greens	Flagel-lates	Total	
1	7-16	3:30 P	231	100	19	113	463	3,240
2	7-16	1:00 P	504	106	9	109	728	10,880
3	7-16	10:30 A	239	16	--	66	321	-
4	7-15	8:00 A	2,135	109	6	11	2,261	-
5 IR	7-15	11:00 A	401	59	13	43	516	-
6	7-15	1:00 P	308	32	--	12	352	-
7	7-15	2:30 P	535	50	6	56	647	-
8 IR	7-15	3:30 P	120	23	69	23	235	-
9 IR	7-15	4:00 P	180	640	46	91	957	-
10	7-14	1:30 P	843	101	--	58	1,002	-
11	7-14	9:00 A	1,286	14	14	143	1,457	-
13 IR	7-13	7:00 A	228	228	46	160	662	-
14	7-13	11:00 A	1,862	221	21	136	2,240	-

IR - Irrigation Return

TABLE Vb

Plankton - Yuma Area

July 19-25, 1961

Station	Date	Time	Phytoplankton Number Organisms per Milliliter					Zooplankton Organisms per Liter
			Diatoms	Greens	Blue-greens	Flagellates	Total	
U.S.-1	7-21	11:00 A	326	147	6	--	479	1,900
U.S.-2	7-21	2:00 P	499	153	33	--	685	2,200
U.S.-2A	7-22	11:00 A	2,080	595	92	23	2,790	-
U.S.-3	7-23	10:00 A	137	480	46	--	663	-
U.S.-4 IR	7-21	10:00 A	2,489	1,285	23	--	3,797	-
U.S.-5 IR	7-21	7:30 A	1,781	1,051	137	--	2,969	-
U.S.-6	7-22	4:30 P	1,753	535	200	17	2,505	900
U.S.-6A	7-22	2:00 P	685	17	51	--	753	2,700
Mex.-7	7-22	3:00 P	788	686	46	--	1,520	-
Mex.-8	7-23	1:00 P	274	514	--	17	805	-
Mex.-9	7-23	11:00 A	594	480	--	17	1,091	-
Mex.-11	7-23	10:00 A	434	160	--	--	594	-
Mex.-12	7-23	1:30 P	925	806	68	--	1,799	-
Mex.-13	7-23	12:00 M	85	240	--	--	325	-
Mex.-14	7-24	8:30 A	134	241	38	19	432	4,450
U.S.-16	7-24	9:30 A	1,257	457	685	--	2,399	-

IR - Irrigation Return

protected coves or pools where some fine silt or organic material had accumulated. Samples in these areas were collected with an Ekman or Petersen dredge usually in water from two to ten feet deep. All samples were preserved in 10 percent formalin and returned to the laboratory for sorting and identification. A summary of bottom animal sample results is shown in Tables VIa and VIb. As riffle and pool samples are not comparable, the results are shown in separate tables. A detailed analyses of samples is shown in Appendix C.

Throughout the section of river studied, the few riffle areas contained fairly large numbers of clean water animals but relatively few types. One species of caddisfly larvae (Potamyia sp.) was present in the largest numbers with somewhat fewer mayfly nymphs, water moth larvae, dragon fly larvae, midge larvae and snails present in most samples. Pool samples contained mostly midges, oligochaetes and snails. Fairly large numbers of the Asiatic clam (Corbicula fluminea) were found in both riffle and pool samples. In some sections near Parker, beds of large clams covered the river bottom almost completely with some beds exceeding an acre in size.

In general, the river in the whole study area, with the possible exception of about twenty miles below Parker Dam, would be considered unproductive of bottom animals. While some animals were fairly abundant in a few selected areas, much of the sand bottom contained few, if any, bottom animals. The types and numbers of organisms found at all stations would indicate no drastic effects on bottom animals from toxicity, oxygen depletion or other changes in water quality.

C. Fish:

Havasu Lake supports a fair sport fishery for warm water species including bass, bluegills, crappie and channel catfish (12). While a few fishermen use the river between Parker Dam and Parker, fishing is discouraged to some extent by the extensive use of high-powered motor boats for racing and water skiing. Trout have been stocked in this area but a trout fishery has not been definitely established. The river from Parker to Cibola Valley is used to a fair extent for fishing, mostly for channel catfish but with some bass, sunfish, etc. taken.

Imperial Reservoir supports an extensive sports fishery mostly for bass and panfish. The sloughs and lakes extending from the river are excellent large mouth bass habitat. The river below Imperial Dam is used to a limited extent for sport fishing, mostly for catfish, mullet and carp. The excessive silt load in this section of the river apparently discourages sight-feeding and nest building game species. The Mexican canals and river below Morelos Dam are used to some extent for fishing, mostly dip or throw netting for mullet and carp.

Some species of fish were observed or collected at all sampling stations, including irrigation canals, in both the Parker and Yuma areas, which would indicate no serious toxicity or oxygen depletion problems. Large schools of mullet were observed near the mouth of the Gila River and in the Colorado River below Yuma. Large numbers of carp were observed immediately below the Yuma sewage outfall.

TABLE VIa

Bottom Animals - Riffle Samples
July 11-25,1961

Number Animals per Square Foot

Kind of Animal	Parker Area					Yuma Area		
	Sta 2	Sta 4	Sta 7	Sta 10	Sta 11	Sta U.S.-1	Sta U.S.-2A	Sta U.S.-6
Ephemeroptera (Mayflies)	4	-	4	6	8	21	9	30
Trichoptera (Caddisflies)	72	25	638	391	395	79	110	105
Lepidoptera (Water moths)	-	50	13	2	10	3	56	-
Odonata (Dragonflies)	-	1	3	9	5	5	-	6
Diptera (True Flies)	-	7	1	-	2	2	26	213
Oligochaeta (Worms)	-	9	3	-	4	7	-	-
Gastropoda (Snails)	18	37	12	-	-	3	4	18
Pelecypoda (Clams)	88	4	68	59	76	7	-	-
Total Number	182	133	742	467	500	127	205	372
Total Weight (grams)	19.5	10.4	57.1	2.3	4.7	5.4	0.9	0.5
Weight Less Mollusks	0.4	0.7	4.0	1.8	2.0	0.9	0.9	0.5
Number of Genera	4	7	9	6	9	10	5	6

TABLE VIb

Bottom Animals - Pool Samples

July 11-25, 1961

Number Animals per Square Foot

Kind of Animal	Parker Area					Yuma Area					
	Sta 1A	Sta 3	Sta 4	Sta 13	Sta 14	Sta U.S.-1	Sta U.S.-5	Sta U.S.-6A	Sta Mex-7	Sta Mex-10	Sta Mex-12
Ephemeroptera (Mayflies)	-	-	-	-	-	10	-	16	20	40	2
Trichoptera (Caddisflies)	-	-	-	-	-	-	-	8	2	-	-
Lepidoptera (Water moths)	-	-	-	-	-	-	-	-	-	-	-
Odonata (Dragonflies)	-	-	-	1	-	7	2	36	14	8	-
Diptera (True Flies)	4	8	-	69	6	20	411	116	100	96	116
Oligochaeta (Worms)	61	10	-	54	6	54	-	148	112	324	30
Gastropoda (Snails)	2	1	-	-	-	22	1	20	10	-	2
Pelecypoda (Clams)	4	68	111	1	2	112	-	52	70	36	8
Total Number	71	87	111	125	14	225	414	396	328	504	158
Total Weight (grams)	0.2	0.2	388	0.6	1.0	23.4	0.2	2.5	1.3	0.5	0.2
Weight Less Mollusks	0.1	0.0	0.0	0.6	0.0	0.2	0.2	1.2	0.6	0.4	0.1
Number of Genera	4	4	1	7	3	12	5	11	13	8	7

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APPENDIX A

Analytical Results
Individual Samples

Station	Date	Time	Temp. °C.	D.O. mg/l	MF Coli/100 ml	Flow cfs
Metropolitan Water District Intake						
1						
(C 199)	7/11/61	10:00 A	26	8.0	< 10	
	7/12	9:30 A	26	10.2	170	
	7/13	6:45 A	27	9.5	4	
	7/14	9:30 A	28	8.8	< 10	
	7/15	8:45 A	29	8.8	4	
	7/16	3:30 P	30	8.4	< 10	
	7/17	7:45 A	28	8.9	2	
			28	8.9	29	
Below Parker Dam						
2						
(C 192)	7/11	11:00 A	24	8.3	40	14,800
	7/12	10:30 A	24	8.0	240	14,500
	7/13	6:00 A	25	8.0	20	14,300
	7/14	9:00 A	25	7.9	< 10	14,400
	7/15	9:15 A	25	7.7	30	14,300
	7/16	2:00 P	25	7.2	16	14,800
	7/17	--	--	--	8	14,800
			25	7.8	52	14,600
Headgate Rock Dam						
3						
(C 184)	7/11	12:36 P	26	7.8	180	
	7/12	11:30 A	26	7.7	230	
	7/13	7:55 A	25	7.2	190	
	7/14	7:50 A	24	7.1	60	
	7/15	10:00 A	28	--	150	
	7/16	10:30 A	25	7.4	100	
	7/17	9:30 A	24	7.3	60	
			25	7.4	139	14,600

APPENDIX A (CONTINUED)

Analytical Results
Individual Samples

Station	Date	Time	Temp. °C.	D.O. mg/l	MF Coli/100 ml	Flow cfs
Colorado Indian Reservation Landing at Parker, Arizona						
4						
(C 181)	7/11/61	1:45P	26	9.5	870	13,900
	7/12	12:01P	26	9.5	1,700	13,600
	7/13	8:20A	26	9.2	800	13,400
	7/14	11:30A	24	9.3	1,000	13,500
	7/15	10:20A	25	9.0	730	13,400
	7/16	7:45A	24	9.4	530	13,900
	7/17	10:30A	25	9.5	82	13,900
			25	9.3	820	13,700
Irrigation Return - Drainage Station West of Poston, Arizona						
5						
(IR 173-1)	7/11	2:35P	28	8.3	800	
	7/12	7:50A	27	7.5	500	
	7/13	7:50A	26	7.6	300	
	7/14	10:25A	26	7.9	160	
	7/15	11:00A	27	7.2	310	
	7/16	8:20A	27	7.8	130	
	7/17	11:15A	28	8.0	110	
			27	7.8	330	19
Colorado River - Indian Camp Ground South of Poston, Arizona						
6						
(C 161)	7/11	5:30P	28	7.8	1,600	
	7/12	10:35A	28	7.9	900	
	7/13	10:00A	25	7.7	860	
	7/14	5:40P	28	--	500	
	7/15	1:30P	27	7.8	70	
	7/16	9:50A	26	7.9	390	
	7/17	1:30P	27	8.0	60	
			27	7.9	630	13,800

APPENDIX A (CONTINUED)

Analytical Results
Individual Samples

Station	Date	Time	Temp. °C.	D.O. mg/l	MF Coli/100 ml	Flow cfs
Colorado River at Palo Verde Dam						
7 (C 150)	7/11/61	4:20P	28	7.8	2,100	
	7/12	9:30A	26	8.7	500	
	7/13	9:30A	25	7.6	640	
	7/14	5:20P	28	7.7	90	
	7/15	--	29	6.6	20	
	7/16	11:45A	26	7.8	800	
	7/17	12:45P	27	7.4	150	
			27	7.7	610	11,260
Irrigation Return - Drainage Return Station 8 1/2 Mile East of Palo Verde Dam						
8 (IR 149-0.5)	7/11	4:10P	32	10.7	900	
	7/12	9:15P	24	6.6	400	
	7/13	8:45P	23	6.0	900	
	7/14	5:00P	31	10.7	300	
	7/15	3:30P	32	8.4	140	
	7/16	11:25A	26	11.4	1,200	
	7/17	12:20P	28	8.4	780	
			28	8.9	780	32
Irrigation Return - Drainage Return Station 9 1 Mile East of Palo Verde Dam						
9 (IR 149-1)	7/11	4:00P	30	7.4	1,400	
	7/12	9:00A	28	6.7	1,000	
	7/13	8:35A	26	6.4	3,000	
	7/14	3:45P	30	7.9	1,900	
	7/15	4:00P	31	8.5	200	
	7/16	11:00A	29	7.3	1,200	
	7/17	12:05P	29	6.9	600	
			29	7.3	1,330	265

APPENDIX A (CONTINUED)

Analytical Results
Individual Samples

Station	Date	Time	Temp. °C.	D.O. mg/1	MF Coli/100 ml	Flow cfs
Blythe Bridge						
10 (C 125)	7/11/61	4:30P	29	7.8	30	11,600
	7/12	4:30P	30	7.4	170	11,300
	7/13	4:00P	29	7.6	180	11,100
	7/14	3:20P	27	7.7	200	11,000
	7/15	8:35A	27	9.5	100	11,100
	7/16	3:25P	28	7.5	140	11,000
	7/17	6:15A	27	6.7	300	11,400
			28	7.7	160	11,200
Cibola Bridge						
11 (C 91)	7/11	11:00A	28	7.2	150	
	7/12	3:30P	31	7.0	400	
	7/13	3:00P	29	7.1	40	
	7/14	9:00A	28	8.0	210	
	7/15	9:30A	27	6.6	800	
	7/16	1:30P	28	6.9	230	
	7/17	10:30A	28	6.9	280	
			28	7.1	300	12,000
Palo Verde Lagoon - Bridge						
12 (IR 84-7)	7/11	10:00A	30	5.2	700	

APPENDIX A (CONTINUED)

Analytical Results
Individual Samples

Station	Date	Time	Temp. °C.	D.O. mg/l	MF Coli/100 ml	Flow cfs
Palo Verde Lagoon - 2 Miles Above Confluence with River						
13 (IR 84-2)	7/11/61	10:30A	28	5.6	1,200	
	7/12	2:00P	30	6.4	1,000	
	7/13	10:00A	28	6.2	1,900	
	7/14	12:20P	27	6.7	900	
	7/15	10:20A	27	5.5	900	
	7/16	12:45P	28	6.0	720	
	7/17	9:40A	28	5.2	110	
			28	5.9	960	800
Cibola Landing and Walter's Camp						
14 (C 75)	7/11	1:30P	28	7.0	110	13,000
	7/12	12:00M	29	8.0	110	12,800
	7/13	12:30P	29	7.0	160	12,500
	7/14	11:00A	28	7.2	250	12,300
	7/15	11:50A	28	7.0	330	12,300
	7/16	11:00A	28	6.3	300	12,300
	7/17	8:30A	28	6.7	260	12,300
			28	7.0	220	12,500
Fisher's Landing - Above Imperial Dam						
U.S.-1 (51)	7/19	9:00A	29	6.8	100	
	7/20	9:45A	30	6.9	100	
	7/21	11:45A	30	7.2	80	
	7/22	2:00P	31	7.2	120	
	7/23	11:55A	28	7.3	110	
	7/24	11:20A	29	7.5	420	
	7/25	11:50A	29	7.2	200	
			30	7.2	160	12,500

APPENDIX A (CONTINUED)

Analytical Results
Individual Samples

Station	Date	Time	Temp. °C	D.O. mg/l	MF Coli/100 ml	Flow cfs
Imperial Dam						
U.S.-2 (C 43)	7/19/61	9:30A	30	7.0	70	
	7/20	10:45A	30	6.6	110	
	7/21	2:00P	30	7.4	900	
	7/22	5:10P	32	6.8	90	
	7/23	12:55P	30	7.4	110	
	7/24	10:25A	29	7.1	210	
	7/25	12:30P	30	7.4	90	
			30	7.1	225	12,000
Colorado River - Above Gila River						
U.S.-3 (C 35)	7/19	2:30P	32	7.3	80	
	7/20	8:30A	30	6.4	400	
	7/21	9:30A	27	6.4	500	
	7/22	12:30P	31	6.9	170	
	7/23	9:00A	27	6.5	210	
	7/24	1:00P	30	7.5	1,300	
	7/25	10:15A	29	7.0	520	
			30	6.9	450	750
Wellton-Mohawk Drain						
U.S.-4 (IR 35-8)	7/19	8:00A	27	6.8	400	
	7/20	9:00A	27	7.3	100	
	7/21	9:30A	27	8.0	--	
	7/22	1:00P	29	9.3	300	
	7/23	11:10A	27	8.0	< 400	
	7/24	11:15A	27	8.0	> 100	
	7/25	10:50A	27	8.0	300	
			27	8.0	270	250

APPENDIX A (CONTINUED)

Analytical Results
Individual Samples

Station	Date	Time	Temp. °C.	D.O. mg/l	MF Coli/100 ml	Flow cfs
Mouth of Gila River						
U.S.-5 (Gi 1)	7/19/61	1:30P	30	7.2	500	
	7/20	8:15A	27	6.1	100	
	7/21	7:30A	26	6.2	200	
	7/22	11:55A	30	7.3	200	
	7/23	8:45A	27	6.6	< 500	
	7/24	12:45P	28	7.2	500	
	7/25	10:00A	27	6.7	< 100	
			29	6.8	300	300
Colorado River - Yuma Water Intake						
U.S.-6 (C 32)	7/19	5:00P	34	7.4	300	1,010
	7/20	11:30A	30	6.7	200	1,030
	7/21	3:30P	33	7.8	300	1,000
	7/22	4:15P	35	7.6	100	1,000
	7/23	3:00P	31	7.7	< 100	991
	7/24	5:00P	32	7.6	600	1,220
	7/25	1:25P	31	7.4	< 100	1,260
			32	7.5	240	1,070
Colorado River - Morelos Dam						
Mex.-7 (C 23)	7/19	12:20P	31	6.6	19,000	3,421
	7/20	8:15A	29	6.4	37,000	3,372
	7/21	2:15P	30	6.7	30,000	3,286
	7/22	1:40P	31	6.9	18,000	3,375
	7/23	2:00P	30	7.5	4,000	--
	7/24	3:50P	31	7.4	7,200	3,673
	7/25	8:10A	29	6.6	3,700	--
			31	7.0	17,000	3,400

APPENDIX A (CONTINUED)

Analytical Results
Individual Samples

Station	Date	Time	Temp. °C.	D.O. mg/l	MF Coli/100 ml	Flow cfs
Alamo Canal - Cuervos						
Mex.-8 (AC 10)	7/19/61	11:30A	31	6.4	38,000	1,970
	7/20	9:30A	30	--	66,000	2,020
	7/21	1:20P	30	6.9	24,000	1,990
	7/22	12:45P	31	6.7	32,000	2,040
	7/23	1:00P	32	7.0	7,700	2,040
	7/24	3:00P	30	7.3	9,300	2,010
	7/25	8:45A	29	6.7	2,400	2,010
			31	6.9	25,600	2,010
Alamo Canal - Represa Cudahy						
Mex.-9 (AC 20)	7/19	10:35A	30	6.4	7,000	519
	7/20	10:25A	--	6.6	4,500	516
	7/21	12:35P	30	--	10,000	553
	7/22	11:30A	31	6.2	2,800	530
	7/23	11:15A	--	--	3,000	491
	7/24	1:55P	31	7.3	3,500	516
	7/25	9:40A	30	8.8	800	516
			30	7.1	4,500	520
Alamo Canal - Respresa Sharps						
Mex.-10 (AC 27)	7/19	--	--	--	--	109
	7/20	11:00A	33	6.1	400	107
	7/21	--	--	--	--	96
	7/22	--	--	--	--	96
	7/23	--	--	--	--	96
	7/24	1:10P	30	5.5	800	105
	7/25	10:20A	31	5.9	300	104
			32	5.8	500	102

APPENDIX A (CONTINUED)

Analytical Results
Individual Samples

Station	Date	Time	Temp. °C.	D.O. mg/l	Coli/100 ml	Flow cfs
Wisteria Canal - Mexicali Intake						
Mex.-11 (WC 49)	7/19/61	8:15A	30	3.3	2,000	
	7/20	12:45P	32	5.8	1,500	
	7/21	9:50A	30	3.9	4,400	
	7/22	10:15A	29	4.0	4,100	
	7/23	10:00A	29	4.6	3,800	
	7/24	10:50A	28	5.1	1,300	
	7/25	10:55A	30	5.3	1,600	
			30	4.6	2,700	7.42
Nuevo Delta Canal - Represa Galeana						
Mex.-12 (NDC 9)	7/19	11:50A	31	7.4	26,000	1,210
	7/20	8:40A	29	6.5	84,000	1,130
	7/21	1:35P	30	7.0	8,300	1,040
	7/22	1:10P	31	7.1	9,800	1,050
	7/23	1:30P	32	7.4	8,400	1,220
	7/24	3:25P	--	--	10,400	1,230
	7/25	8:30P	29	6.8	6,000	1,110
			31	7.2	21,800	1,140
Nuevo Delta Canal - 6.3 Miles South of Bataques						
Mex.-13 (NDC 26)	7/19	--	--	--	--	
	7/20	10:00A	31	8.2	800	
	7/21	11:50A	31	8.9	400	
	7/22	11:55A	31	10.0	210	
	7/23	12:00M	32	9.8	800	
	7/24	2:25P	32	11.6	< 100	
	7/25	9:15A	30	7.7	200	
			32	9.6	420	64

APPENDIX A (CONTINUED)

Analytical Results
Individual Samples

Station	Date	Time	Temp. °C.	D.O. mg/l	MF Coli/100 ml	Flow cfs
Colorado River - Mexicali - San Luis Highway						
Mex.-14 (C 0)	7/19/61	--	--	--	--	
	7/20	2:50P	36	8.8	400	
	7/21	9:50A	30	7.8	220	
	7/22	9:05A	29	7.6	300	
	7/23	11:50A	30	8.1	2,200	
	7/24	11:30A	--	--	1,100	
	7/25	3:15P	34	8.3	300	
			32	8.1	750	7.8
Bacanora Canal - 10 Miles, South of San Luis						
Mex.-15 (BC 6)	7/19	5:30P	34	7.1	2,000	342
	7/20	3:55P	34	7.2	400	340
	7/21	9:00A	30	6.9	870	339
	7/22	9:50A	30	6.9	2,400	338
	7/23	9:50A	29	7/1	1,200	336
	7/24	10:45A	31	7.6	1,900	335
	7/25	3:45P	32	7.2	800	333
			31	7.1	1,400	338
Canal Sanchez Mejorada - Start U.S. Side of Fence at San Luis, Ariz., Lift Station						
U.S.-16 (SMC 0)	7/19	4:10P	31	5.9	8,000	
	7/20	4:50P	30	6.4	2,300	
	7/21	10:10A	28	5.6	4,000	
	7/22	8:50A	27	5.2	4,300	
	7/23	11:10A	27	5.6	5,900	
	7/24	9:30A	28	5.4	9,000	
	7/25	2:45P	30	6.2	1,000	
			29	5.6	5,000	190

APPENDIX A (CONTINUED)

Analytical Results
Individual Samples

Station	Date	Time	Temp. °C.	D.O. mg/l	MF Coli/100 ml	Flow cfs
Sanchez Mejorada - 3.84 Miles South of San Luis, Sonora, Mexico						
Mex.-17 (SMC 4)	7/19/61	5:00P	31	5.6	11,000	196
	7/20	3:45P	32	5.8	3,600	191
	7/21	9:25A	28	5.7	8,300	182
	7/22	9:30A	29	5.6	7,100	191
	7/23	10:10A	28	5.9	7,200	189
	7/24	10:00A	28	5.8	6,600	185
	7/25	3:30P	30	6.4	600	187
			29	5.8	6,300	190
Sanchez Mejorada - 9.5 Miles South of San Luis, Sonora, Mexico						
Mex.-18 (SMC 12)	7/19	5:45P	31	5.6	5,000	
	7/20	4:15P	32	6.2	1,700	
	7/21	8:35A	29	6.2	3,200	
	7/22	10:10A	29	6.2	2,700	
	7/23	9:45A	28	6.2	5,500	
	7/24	10:30A	29	6.0	5,400	
	7/25	4:15P	30	6.2	1,000	
			30	6.1	3,900	129

APPENDIX B

Analytical Results
Individual Samples

Station	Date Collected	Time	Turbidity mg/l	Spec. Cond. μ mhos	pH	Alkalinity mg/l $CaCO_3$	Hardness mg/l $CaCO_3$
Parker Survey Area - July 11-17, 1961							
Metropolitan Water District Intake							
1							
(C 200)	7/16/61	3:30P	< 7	1,100	8.1	110	365
Parker Dam - Face							
1A--Surface							
(C 198)	7/16	2:30P	< 7	1,100	8.1	128	330
1A--100' Depth							
(C 198)	7/16	3:00P	--	1,100	7.4	108	385
Below Parker Dam							
1B							
(C 197)	7/16	2:00P	< 7	1,025	7.7	126	350
6 Miles below Parker Dam							
2							
(C 192)	7/16	1:00P	11	1,050	7.8	126	360
Headgate Rock Dam							
3							
(C 184)	7/16	10:30A	< 7	1,100	8.0	124	346
Indian Reservation Dock							
4							
(C 181)	7/15	8:00A	< 7	1,000	8.1	140	380
Above Ind. Res. Drain at Poston							
4A							
(C 173)	7/15	10:30A	< 7	1,000	8.0	130	360
Ind. Res. Drain near Poston							
5							
(IR 173-1)	7/15	11:00A	22	1,100	8.1	130	365
Indian Camp Ground							
6							
(C 161)	7/15	1:00P	9	1,000	8.1	122	360

APPENDIX B(CONTINUED)

Analytical Results
Individual Samples

Station	Date Collected	Time	Turbidity mg/l	Spec. Cond. μ mhos	pH	Alkalinity mg/l $CaCO_3$	Hardness mg/l $CaCO_3$
Parker Survey Area - July 11-17, 1961							
Above Palo Verde Diversion Dam							
7							
(C 150)	7/15/61	2:30P	9	1,050	8.1	130	335
Drain - 1/2 Mile East of Palo Verde Dam - West Drain							
8							
(IR 149-0.5)	7/15	3:00P	< 7	1,200	8.4	150	390
Drain - 1 Mile East of Palo Verde Dam - East Drain							
9							
(IR 149-1)	7/15	3:30P	50	2,600	8.5	212	715
Blythe Bridge							
10							
(C 125)	7/11	4:30P	--	1,000	8.1	140	366
	7/12	4:30P	16	950	8.1	134	345
	7/13	4:00P	17	1,000	8.1	132	385
	7/14	1:30P	16	1,050	8.1	132	370
Cibola Bridge							
11							
(C 91)	7/11	11:00A	18	1,150	8.1	--	386
	7/12	3:30P	--	1,100	8.1	132	365
	7/13	3:00P	--	1,000	8.0	138	370
	7/14	9:00A	16	1,100	8.1	124	380
Palo Verde Lagoon - Bridge							
12							
(IR 84-7)	7/11	10:00A	--	2,300	7.7	260	575
Palo Verde Lagoon - 2 Miles above Conflunce							
13							
(IR 84-2)	7/11	10:30A	70	2,700	7.9	270	550
	7/12	2:00P	95	2,500	7.8	250	510
	7/13	10:00A	45	--	7.6	250	555

APPENDIX B (CONTINUED)

Analytical Results
Individual Samples

Station	Date Collected	Time	Turbidity mg/l	Spec. Cond. μ mhos	pH	Alkalinity mg/l $CaCO_3$	Hardness mg/l $CaCO_3$
Parker Survey Area - July 11-17, 1961							
Cibola Landing and Walter's Camp 14							
(C 75)	7/11/61	1:30P	22	1,100	8.2	142	375
	7/12	12:00M	22	1,100	7.9	148	380
	7/13	12:30P	16	1,100	8.0	138	375
Yuma Survey Area - July 19-25,1961							
Fisher's Landing - Above Imperial Dam							
U.S.-1							
(C 51)	7/19	9:00A	--	1,150	8.2	136	355
	7/21	11:00A	19	1,125	8.2	134	390
Imperial Dam							
U.S.-2							
(C 43)	7/19	9:30A	--	1,150	8.0	136	360
	7/21	2:00P	19	1,175	8.2	136	365
Below Laguna Dam							
U.S.-2A							
(C 39)	7/19	10:30A	45	1,125	8.1	134	395
	7/22	11:00A	50	1,200	8.0	136	360
Above Gila River							
U.S.-3							
(C 36)	7/19	2:30P	32	1,200	8.1	142	400
	7/21	8:30A	27	1,225	8.1	148	370
	7/23	10:00A	--	1,300	8.1	140	385
Wellton-Mohawk Drain							
U.S.-4							
(IR 36-8)	7/19	8:00A	45	10,000	7.6	252	2,460
	7/21	10:00A	30	9,000	7.7	290	2,400
Mouth of Gila River							
U.S.-5							
(Gi 1)	7/19	1:30P	45	10,000	7.7	246	2,240
	7/21	7:30A	55	9,100	7.7	258	2,260

APPENDIX B (CONTINUED)

Analytical Results
Individual Samples

Station	Date Collected	Time	Turbidity mg/l	Spec. Cond. μ mhos	pH	Alkalinity mg/l $CaCO_3$	Hardness mg/l $CaCO_3$
Yuma Survey Area - July 19-25, 1961							
Yuma Water Intake							
U.S.-6							
(C 32)	7/19/61	5:00P	40	3,100	8.0	190	850
	7/21	3:00P	35	3,400	8.0	182	870
	7/22	4:30P	35	3,300	8.1	182	825
Above Pilot Knob Wasteway							
U.S.-6A							
(C 26)	7/22	2:00P	35	2,200	8.1	156	600
Morelos Dam							
Mex.-7							
(C 23)	7/19	4:00P	--	1,700	8.1	148	520
	7/22	3:00P	35	2,200	8.2	156	590
	7/23	2:00P	--	1,700	8.0	144	495
Alamo Canal - Cuervos							
Mex.-8							
(AC 10)	7/20	9:30A	--	1,750	8.0	144	485
	7/23	1:00P	--	1,700	8.0	144	500
Alamo Canal - Represa Cudahy							
Mex.-9							
(AC 20)	7/20	10:30A	25	1,750	8.1	164	505
	7/23	11:00A	25	1,800	8.1	150	505
Alamo Canal - Represa Sharps							
Mex.-10							
(AC 27)	7/20	11:00A	35	1,750	7.8	136	490
Wisteria Canal - Mexicali Intake							
Mex.-11							
(WC 49)	7/20	12:15P	40	1,700	7.6	144	465
	7/23	10:00A	35	1,700	7.6	134	495
New Delta Canal - Represa Galeana							
Mex.-12							
(NDC 9)	7/20	9:00A	--	1,850	8.0	150	505
	7/23	1:30P	--	1,700	7.9	146	500

APPENDIX B (CONTINUED)

Analytical Results
Individual Samples

Station	Date Collected	Time	Turbidity mg/l	Spec. Cond. μ mhos	pH	Alkalinity mg/l $CaCO_3$	Hardness mg/l $CaCO_3$
Yuma Survey Area - July 19-25, 1961							
New Delta Canal - South of Bataques							
Mex.-13 (NDC 26)	7/20/61	10:00A	25	1,750	8.1	160	485
	7/23	12:00M	22	1,800	8.1	148	505
San Luis-Mexicali Highway - Near Mexico-U.S. Border							
Mex.-14 (C 0)	7/20	2:30P	35	1,800	7.8	132	510
	7/24	11:30A	20	1,300	8.2	130	405
Bacanora Canal - 8 Miles South of San Luis							
Mex.-15 (BC 6)	7/20	4:00P	45	1,800	7.8	150	530
	7/24	11:00A	30	1,700	8.0	154	500
Sanchez Mejorada Canal - San Luis, Arizona, Lift Station							
U.S.-16 (SMC 0)	7/20	5:00P	45	2,600	7.8	236	645
	7/24	9:30A	55	2,400	7.8	228	680
Sanchez Mejorada Canal - 4 Miles South of San Luis, Sonora							
Mex.-17 (SMC 4)	7/20	3:45P	45	2,500	7.6	220	635
	7/24	10:00A	55	2,400	7.8	224	600
Sanchez Mejorada Canal - 10 Miles South of San Luis, Sonora							
Mex.-18 (SMC 12)	7/20	4:30P	90	2,300	7.8	206	600
	7/24	10:30A	60	2,300	7.8	224	625

APPENDIX C

Bottom Animals - Parker Survey
Riffle Samples - July 11-17, 1961

Kind of Animal 1/	Number of Animals per Square Foot				
	Sta. 2	Sta. 4	Sta. 9	Sta. 10	Sta. 11
Date Collected:	7/16	7/15	7/15	7/14	7/14
Ephemeroptera (Mayflies)					
Baetis sp.	4	-	4	6	8
Caenis sp.	-	-	-	-	-
Trichoptera (Caddisflies)					
Parapsyche sp.	72	-	-	-	-
Potamyia sp.	-	25	638	391	395
Lepidoptera (Water moths)					
Paragyractis sp.	-	50	13	2	10
Odonata (Dragonflies and Damselflies)					
Gomphus sp.	-	-	-	-	-
Erpetogomphus sp.	-	1	-	1	1
Argia sp.	-	-	-	-	-
Hyponeura Lugens	-	-	2	8	4
Others (3 Genera)	-	-	1	-	-
Diptera (True Flies)					
Tendipedidae (Midges)					
Calopsectra sp.	-	-	-	-	1
Procladius sp.	-	-	1	-	-
Prodiamesa sp.	-	-	-	-	-
Glyptotendipes sp.	-	-	-	-	-
Other midges (5 Genera)	-	7	-	-	-

APPENDIX C (CONTINUED)

Bottom Animals - Parker Survey
Riffle Samples - July 11-17, 1961

Kind of Animal [1]	Number of Animals per Square Foot				
	Sta. 2	Sta. 4	Sta. 9	Sta. 10	Sta. 11
Date Collected:	7/16	7/15	7/15	7/14	7/14
Other Diptera	-	-	-	-	1
Annelida (Aquatic worms)					
Limnodrilus sp.	-	8	3	-	4
Tubifex sp.	-	-	-	-	-
Others	-	1	-	-	-
Gastropoda (Snails)					
Physa sp.	18	37	12	-	-
Others	-	-	-	-	-
Pelecypoda (Clams)					
Corbicula Fluminea	88	4	51	-	-
Others [2]	-	-	17	59	76
Number of Genera	4	7	9	6	9
Number of Animals	182	133	742	467	500
Total Weight (Grams)	19.48	10.37	57.13	2.27	4.74
Weight of Mollusks	19.10	9.66	53.09	0.45	2.71
Weight - Less Mollusks	0.38	0.71	4.04	1.82	2.03

APPENDIX C (CONTINUED)

Bottom Animals - Yuma Survey
Riffle Samples - July 19-25,1961

Kind of Animal 1/	Number of Animals per Square Foot		
	Sta. US-1	Sta. US-2A	Sta. US-6
Date Collected:	7/21	7/21	7/22
Ephemeroptera (Mayflies)			
Baetis sp.	21	9	30
Caenis sp.	-	-	-
Trichoptera (Caddisflies)			
Parapsyche sp.	-	-	-
Potamyia sp.	79	110	105
Lepidoptera (Water Moths)			
Paragyractis sp.	3	56	-
Odonata (Dragonflies and Damselflies)			
Gomphus sp.	-	-	-
Erpetogomphus sp.	-	-	-
Argia sp.	-	-	5
Hyponeura Lugens	5	-	-
Others (3 Genera)	-	-	1
Diptera (True Flies)			
Tendipedidae (Midges)			
Calopsectra sp.	2	-	-
Procladius sp.	-	-	-
Prodiamesa sp.	-	-	213
Glyptotendipes sp.	-	-	-
Other Midges (5 Genera)	-	26	-

APPENDIX C (CONTINUED)

Bottom Animals - Yuma Survey
Riffle Samples - July 19-25, 1961

Kind of Animal [1]	Number of Animals per Square Foot		
	Sta. US-1	Sta. US-2A	Sta. US-6
Date Collected:	7/21	7/21	7/22
Other Diptera	-	-	-
Annelida (Aquatic worms)			
Limnodrilus sp.	3	-	-
Tubifex sp.	1	-	-
Others	3	-	-
Gastropoda (Snails)			
Physa sp.	3	4	18
Others	-	-	-
Pelecypoda (Clams)			
Crobicula fluminea	7	-	-
Others [2]	-	-	-
Number of Genera	10	5	6
Number of Animals	127	205	372
Total Weight (grams)	5.38	0.93	0.48
Weight of Mollusks	4.50	0.05	0.03
Weight less Mollusks	0.88	0.88	0.45

APPENDIX C (CONTINUED)

Bottom Animals - Parker Survey
Pool Samples - July 11-17, 1961

Kind of Animal 1/	Number of Animals per Square Foot				
	Sta. 1A	Sta. 3	Sta. 4	Sta. 13	Sta. 14
Date Collected:	7/16	7/16	7/15	7/13	7/13
Ephemeroptera (Mayflies)					
Baetis sp.	-	-	-	-	-
Caenis sp.	-	-	-	-	-
Trichoptera (Caddisflies)					
Parapsyche sp.	-	-	-	-	-
Potamyia sp.	-	-	-	-	-
Lepidoptera (Water Moths)					
Paragyractis sp.	-	-	-	-	-
Odonata (Dragonflies and Damselflies)					
Gomphus sp.	-	-	-	1	-
Erpetogomphus sp.	-	-	-	-	-
Argia sp.	-	-	-	-	-
Hyponeura lugens	-	-	-	-	-
Others (3 Genera)	-	-	-	-	-
Diptera (True Flies)					
Tendipedidae (Midges)					
Calopsectra sp.	-	-	-	32	6
Procladius sp.	4	-	-	-	-
Prodiamesa sp.	-	-	-	-	-
Glyptotendipes sp.	-	-	-	35	-
Other Midges (5 Genera)	-	8	-	1	-

APPENDIX C (CONTINUED)

Bottom Animals - Parker Survey
Pool Samples - July 11-17, 1961

Kind of Animal 1/	Number of Animals per Square Foot				
	Sta. 1A	Sta. 3	Sta. 4	Sta. 13	Sta. 14
Date Collected:	7/16	7/16	7/15	7/13	7/13
Other Diptera	-	-	-	1	-
Annelida (Aquatic Worms)					
Limnodrilus sp.	61	10	-	54	6
Tubifex sp.	-	-	-	-	-
Others	-	-	-	-	-
Gastropoda (Snails)					
Physa sp.	2	1	-	-	-
Others	-	-	-	-	-
Pelecypoda (Clams)					
Corbicula fluminea	-	-	111	-	2
Others 2/	4	68	-	1	-
Number of Genera	4	4	1	7	3
Number of Animals	71	87	111	125	14
Total Weight (grams)	0.18	0.20	388	0.58	1.02
Weight of Mollusks	0.07	0.18	388	.02	1.01
Weight - Less Mollusks	0.11	0.02	0.0	0.56	0.01

APPENDIX C (CONTINUED)

Bottom Animals - Yuma Survey
Pool Samples - July 19-25, 1961

Kind of Animal 1/	Number of Animals per Square Foot					
	Sta. US-1	Sta. US-5	Sta. US-6A	Sta. Mex-7	Sta. Mex-10	Sta. US-16
Date Collected:	7/21	7/21	7/22	7/22	7/23	7/24
Ephemeroptera (Mayflies)						
Baetis sp.	2	-	16	20	40	2
Caenis sp.	8	-	-	-	-	-
Trichoptera (Caddisflies)						
Parapsyche sp.	-	-	-	-	-	-
Potamyia sp.	-	-	8	2	-	-
Lepidoptera (Water moths)						
Paragyractis sp.	-	-	-	-	-	-
Odonata (Dragonflies and Damselflies)						
Gomphus sp.	-	-	-	4	-	-
Erpetogomphus sp.	-	-	-	-	-	-
Argia sp.	2	1	20	10	-	-
Hyponeura lugens	-	1	-	-	-	-
Others (3 Genera)	5	-	16	-	8	-
Diptera (True Flies)						
Tendipedidae (Midges)						
Calopsectra sp.	6	409	112	74	96	112
Procladius sp.	9	-	-	-	-	-
Prodiamesa sp.	-	-	4	22	-	-
Glyptotendipes sp.	-	-	-	-	-	-
Other midges (5 Genera)	5	-	-	2	-	4

APPENDIX C (CONTINUED)

Bottom Animals - Yuma Survey
Pool Samples - July 19-25, 1961

Kind of Animal 1/	Number of Animals per Square Foot					
	Sta. US-1	Sta. US-5	Sta. US-6A	Sta. Mex-7	Sta. Mex-10	Sta. US-16
Date Collected:	7/21	7/21	7/22	7/22	7/23	7/24
Other Diptera	-	2	-	2	-	-
Annelida (Aquatic worms)						
Limnodrilus sp.	51	-	128	62	288	28
Tubifex sp.	3	-	16	48	20	-
Others	-	-	4	2	16	2
Gastropoda (Snails)						
Physa sp.	21	1	20	10	-	-
Others	1	-	-	-	-	2
Pelecypoda (Clams)						
Corbicula fluminea	3	-	-	-	-	-
Others 2/	109	-	52	70	36	8
Number of Genera	12	5	11	13	8	7
Number of Animals	225	414	396	328	504	158
Total Weight (grams)	23.42	0.24	2.48	1.34	0.52	0.18
Weight of Mollusks	23.20	0.01	1.28	.76	.08	0.06
Weight - Less Mollusks	0.22	0.23	1.20	0.58	0.44	0.12

1/ Identification by A. R. Gaufin, Professor, Biology Department, University of Utah, Salt Lake City, Utah.

2/ Possibly Corbicula fluminea - too small to identify.